

Inventors: Dekel *et al.*

Title: "SYSTEM AND METHOD FOR THE LOSSLESS PROGRESSIVE STREAMING OF IMAGES OVER A COMMUNICATION NETWORK"

Serial No.: 09/837,862

Docket No.: 18104.0011U1

Filing Date: April 17, 2001

Contact: Lawrence D. Maxwell, Esq. (404) 688-0770

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SYSTEM ARCHITECTURE BLOCK DIAGRAM

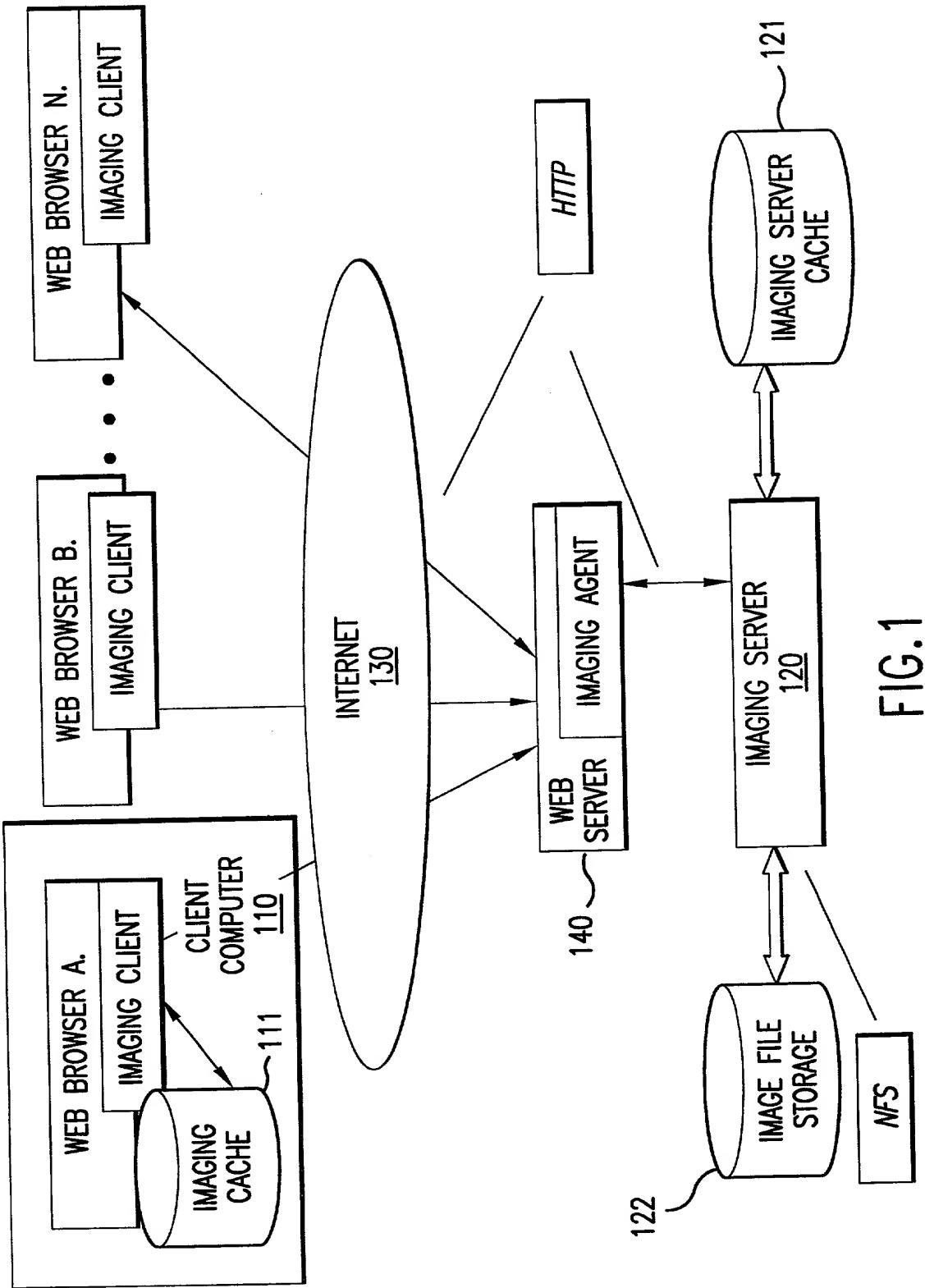


FIG. 1

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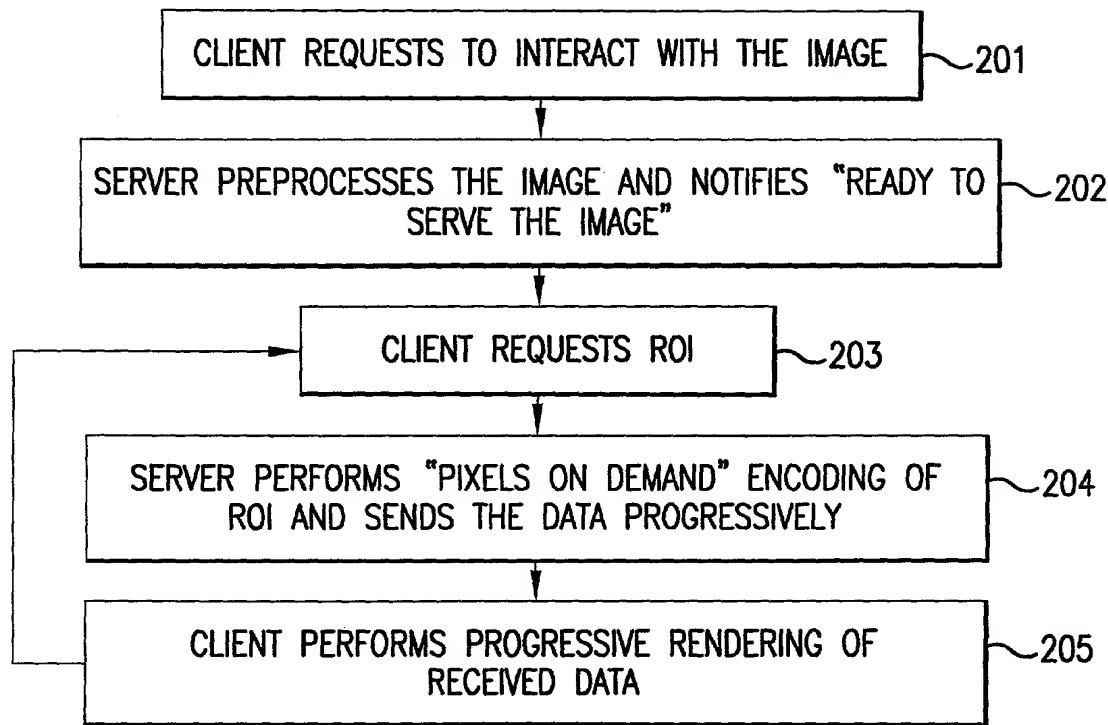


FIG.2

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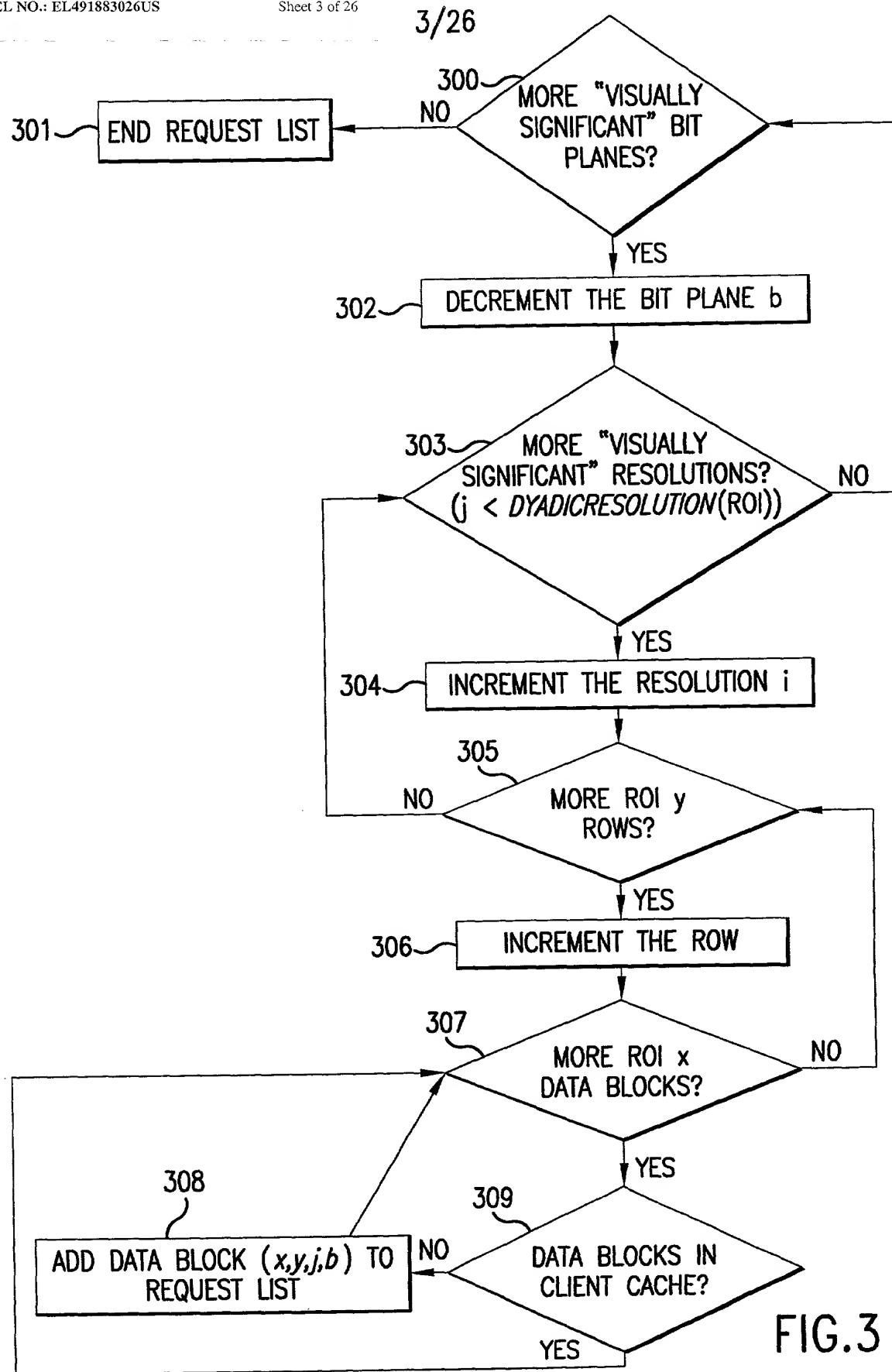


FIG.3

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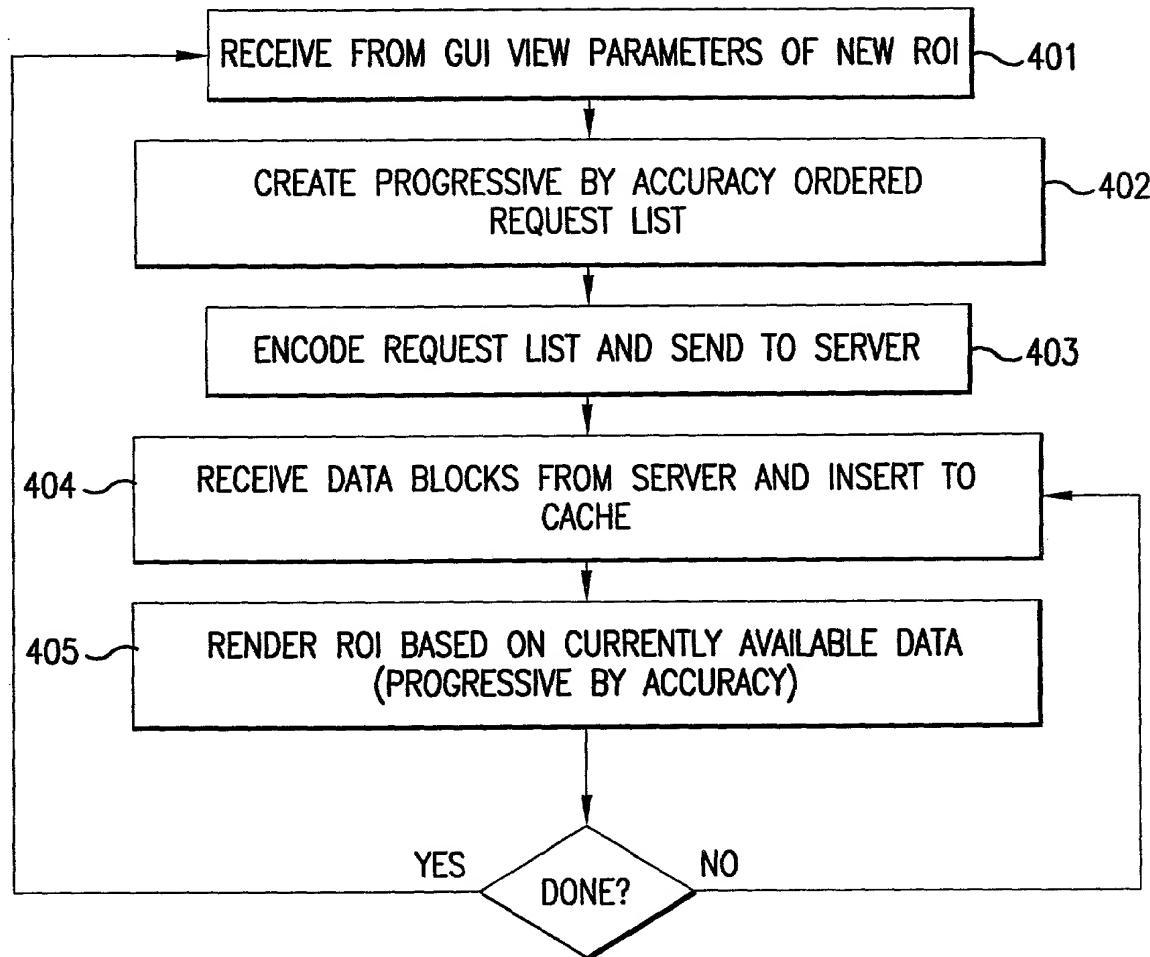


FIG.4

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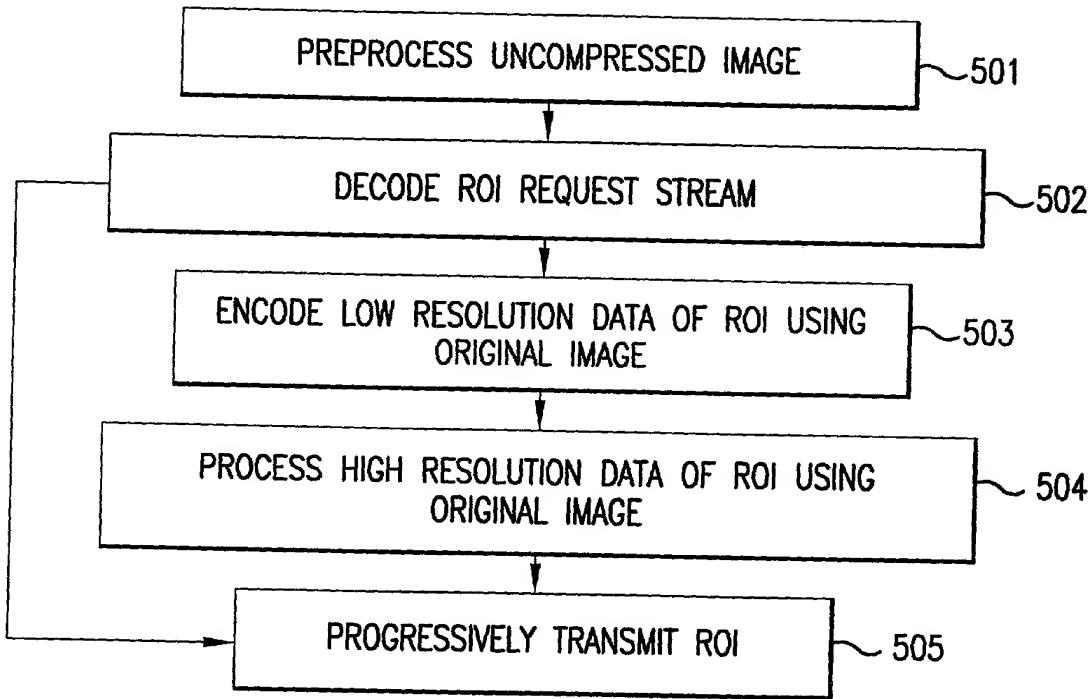


FIG.5

09837862-00110

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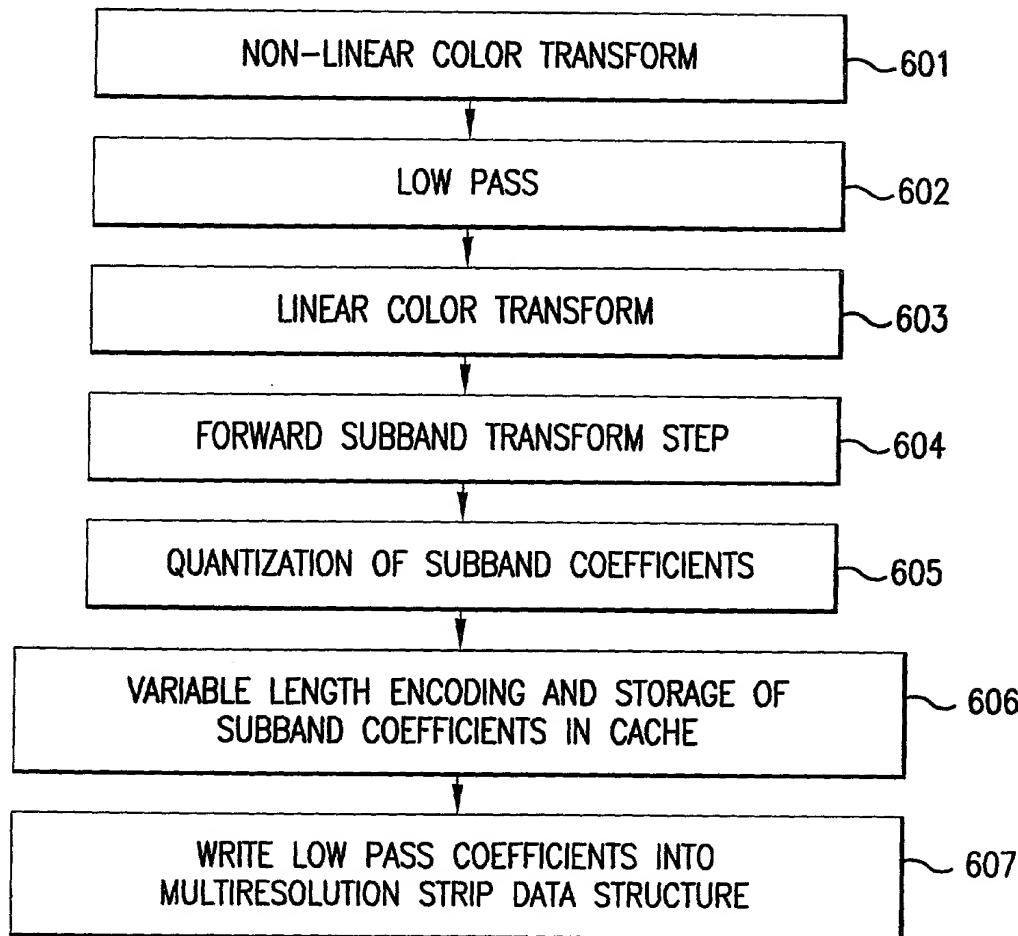


FIG. 6

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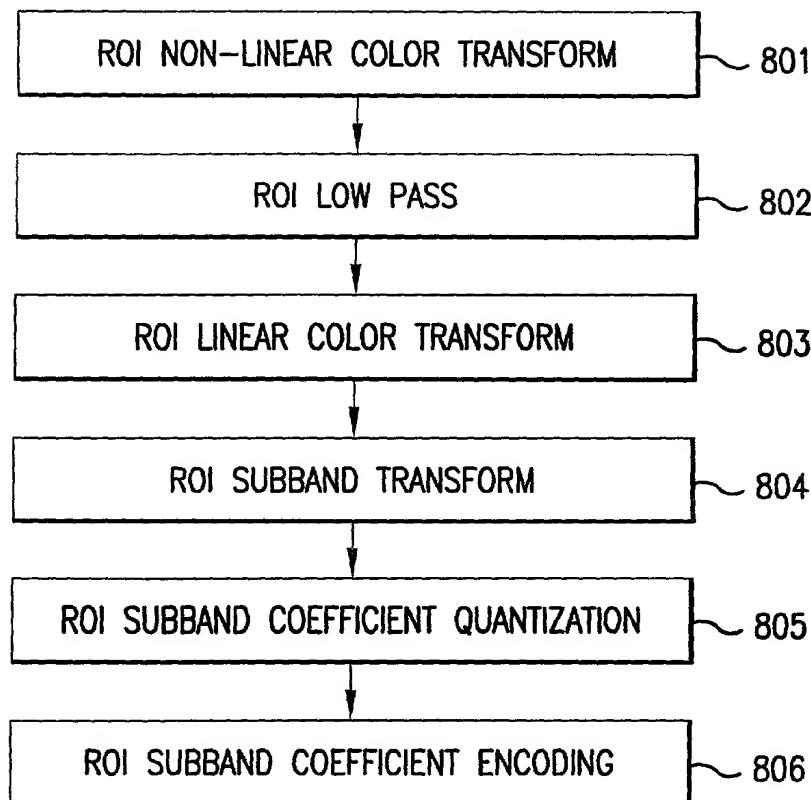


FIG.8

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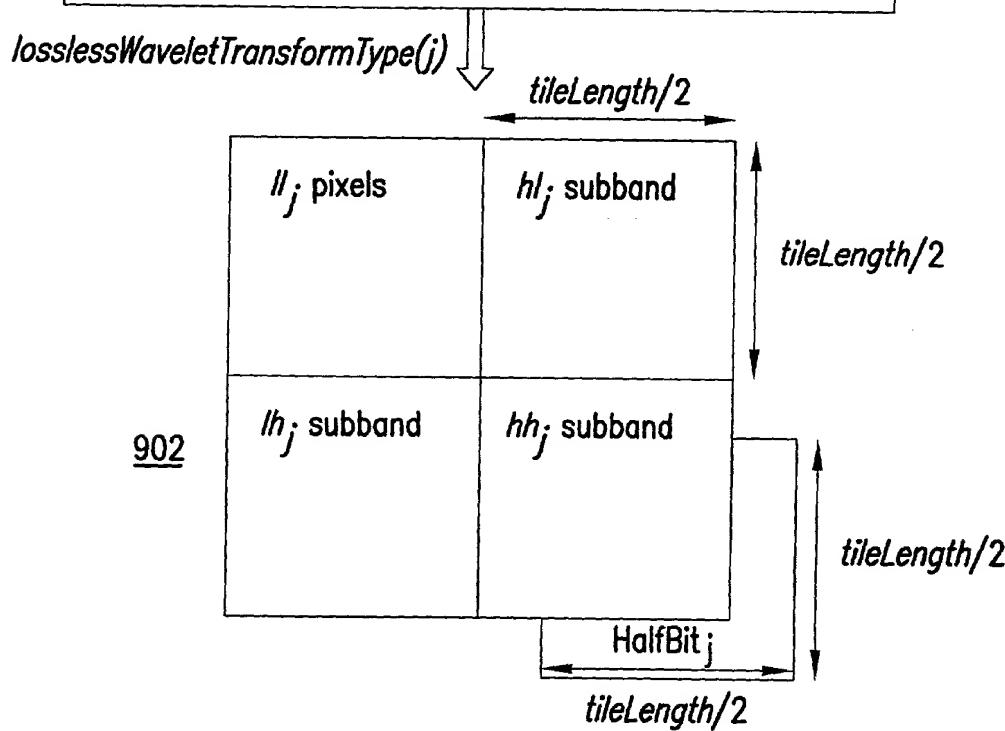
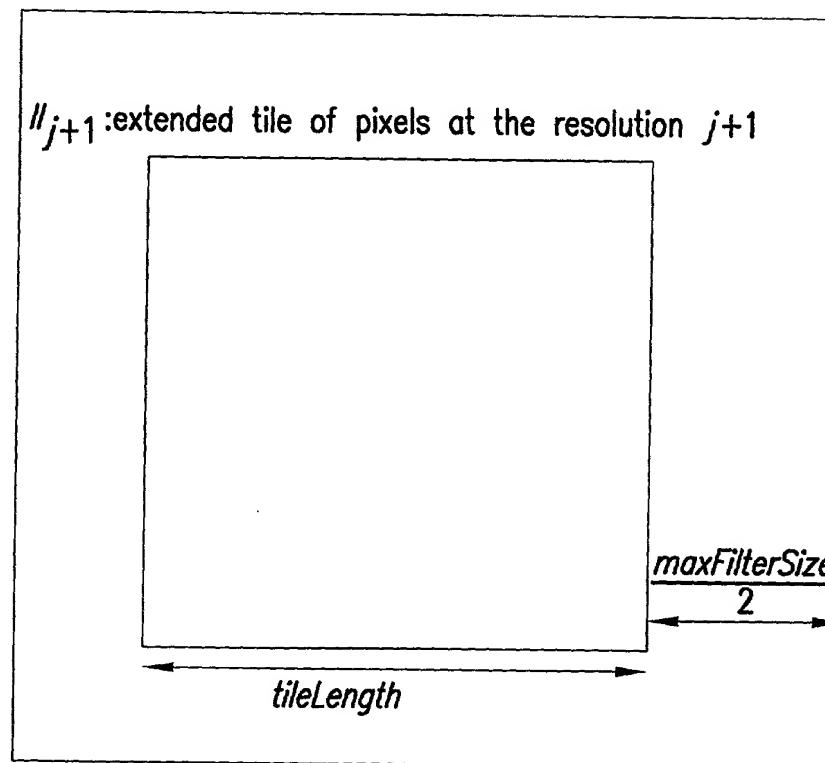


FIG.9

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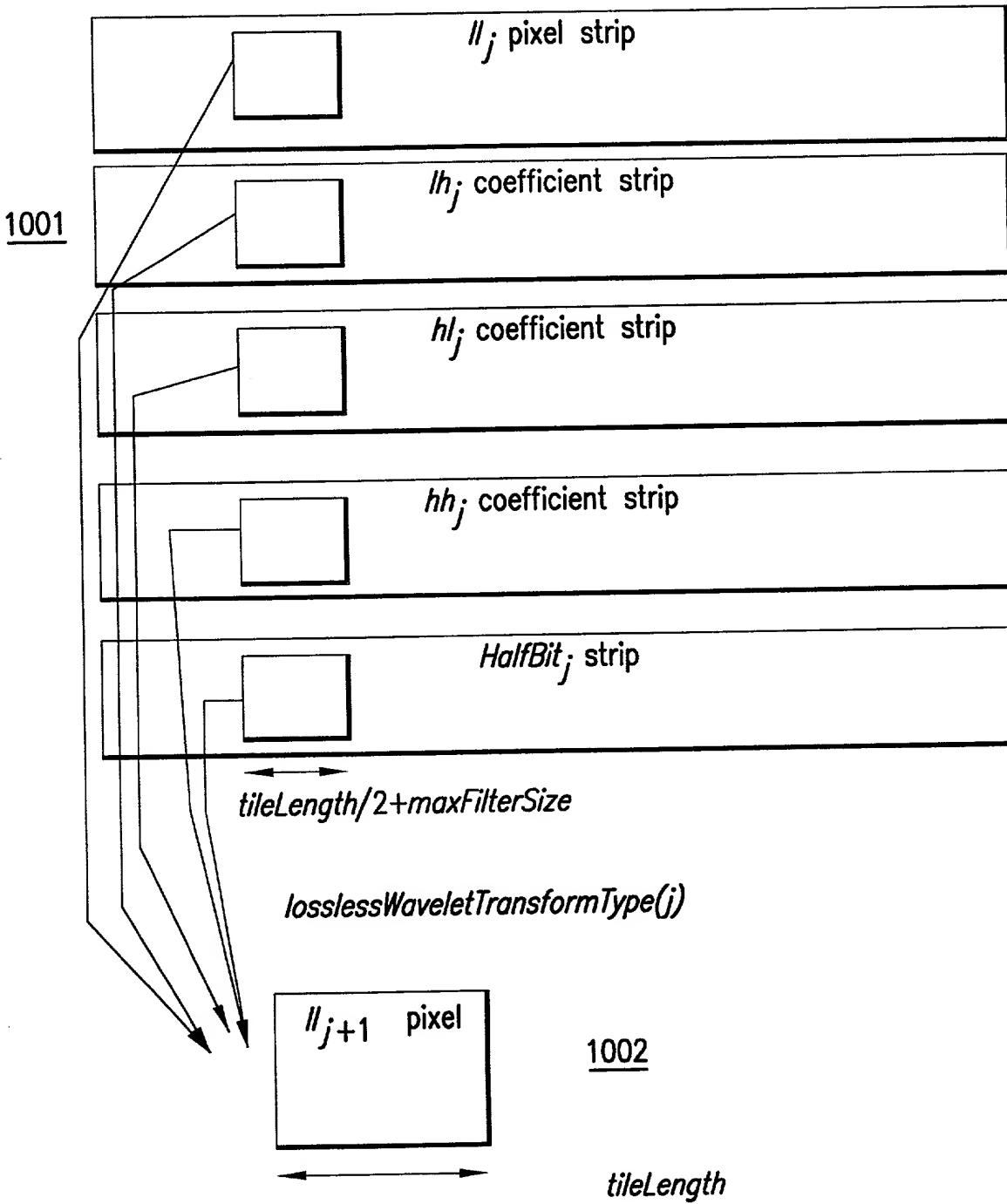


FIG.10

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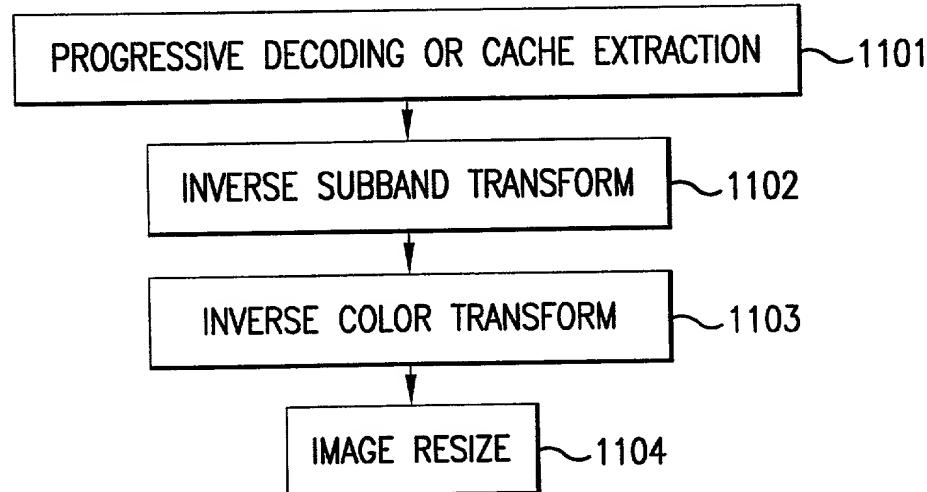


FIG.11

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1201

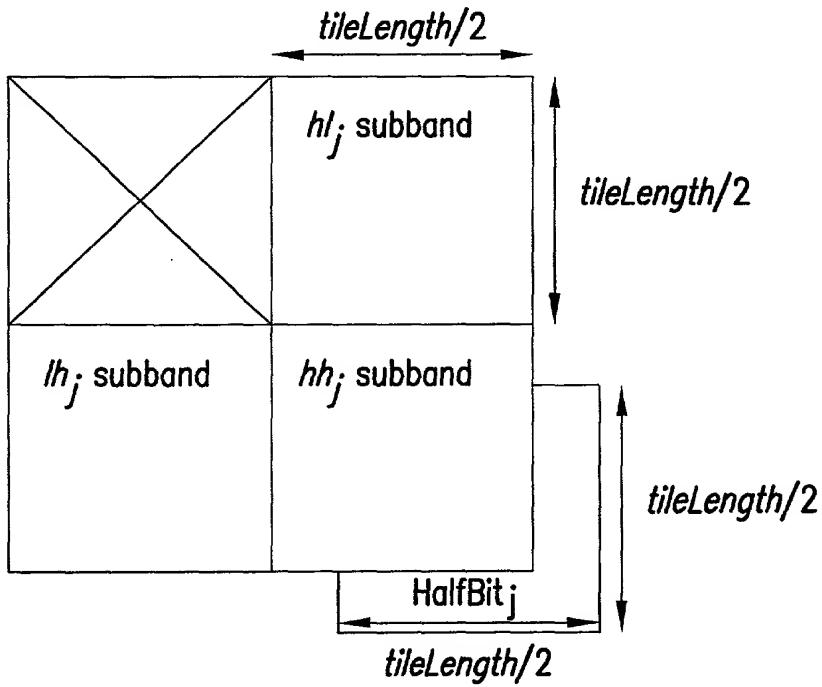


FIG.12

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RGB <-> YUV REVERSIBLE CONVERSION

FORWARD:

$$Y_r = \left\lfloor \frac{R + 2G + B + 2}{4} \right\rfloor$$

$$U_r = R - G$$

$$V_r = B - G$$

INVERSE:

1301

$$G = Y_r - \left\lfloor \frac{U_r + V_r + 2}{4} \right\rfloor$$

$$R = U_r + G$$

$$B = V_r + G$$

FIG.13

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1401

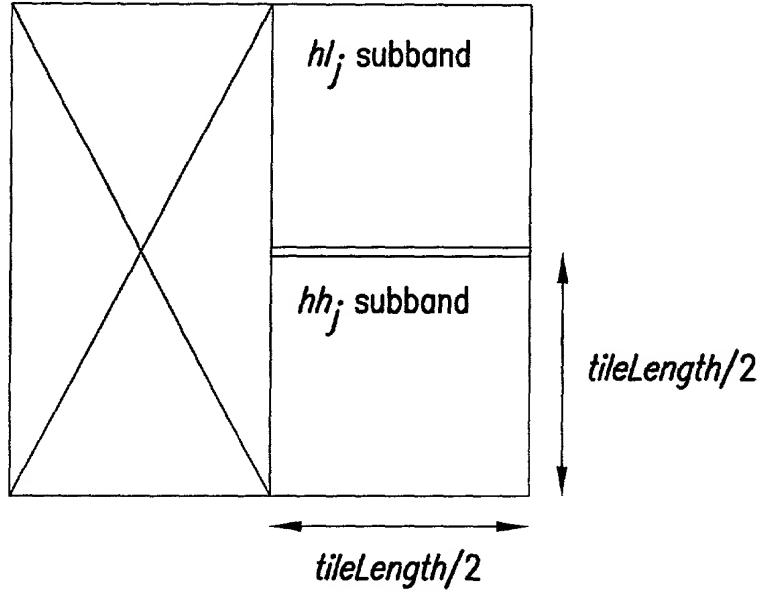


FIG.14

Inventors: Dekel et al.

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```
bitModel.startModel () ;  
zeroCoefModel.startModel () ;  
coefSignModel.startModel () ;  
  
while (encoder.moreCoef ()) {  
    if (encoder.isCoefReported ()) {  
  
        arithmetic_encode_symbol (bitModel,encoder.reportedCoefPrecisionBit ()) ;  
    }  
    else {  
        if (encoder.isCoefExactZero ()) ;  
        arithmetic_encode_symbol (zeroCoefModel,true) ;  
        else {  
            arithmetic_encode_symbol (zeroCoefModel,false) ;  
            arithmetic_encode_symbol (coefSignModel,encoder.getCoefSign ()) ;  
        }  
    }  
}
```

FIG.15a

```
bitModel.startModel () ;  
  
for (int i = 0 ; i < hBlockSize ; i++) {  
    for (int j = 0 ; j < hBlockSize ; j++) {  
        arithmetic_encode_symbol (bitModel,  
        coefHalfBit [i] [j]) ;  
    }  
}
```

FIG.15b

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```
bitModel.startModel() ;  
zeroCoefModel.startModel() ;  
coefSignModel.startModel() ;  
  
decoder.initializeLSBPlaneCoefScan () ;  
  
while (decoder.moreCoef ()) {  
    if (decoder.isCoefReported ()) {  
        if (decoder.isLHCoef ()) {  
            decoder.updateLSB (0) ;  
        }  
        else {  
            decoder.updateLSB (arithmetic_decoder_symbol (bitModel)) ;  
        }  
    }  
    else {  
        if (!decoder.isLHCoef ()) {  
            if (!arithmetic_decoder_symbol (zeroCoefModel))  
                decoder.setLSB (arithmetic_decoder_symbol (coefSignMode  
1)) ;  
        }  
    }  
}  
}
```

FIG.16a

```
bitModel.startModel () ;  
for (int i = 0 ; i < hBlockSize ; i++) {  
    for (int j = hBlockSize ; j ; j--,p++) {  
        coefHalfBit [i] [j] = arithmetic_decoder_symbol (bitModel) ;  
    }  
}
```

FIG.16b

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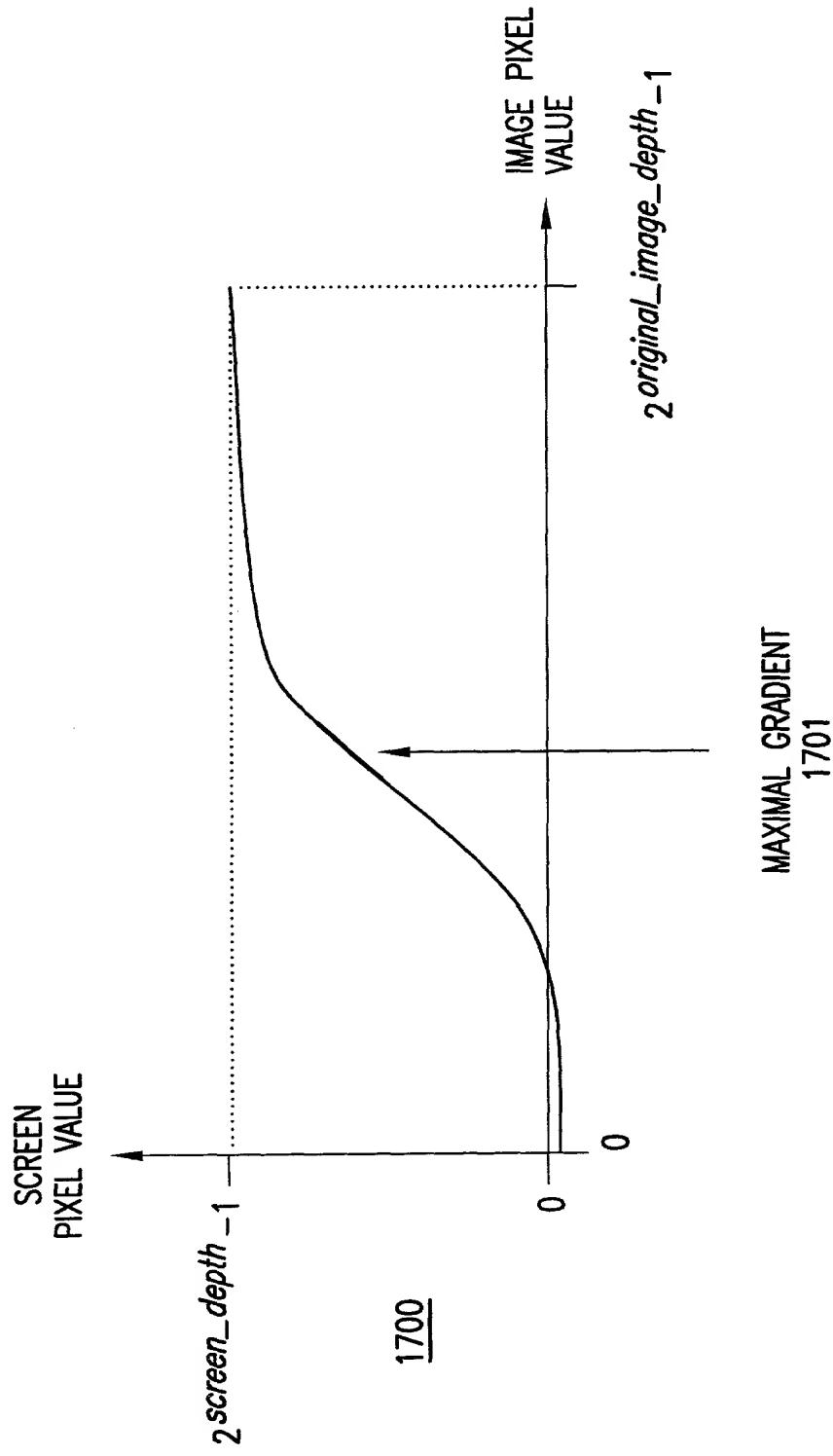


FIG. 17

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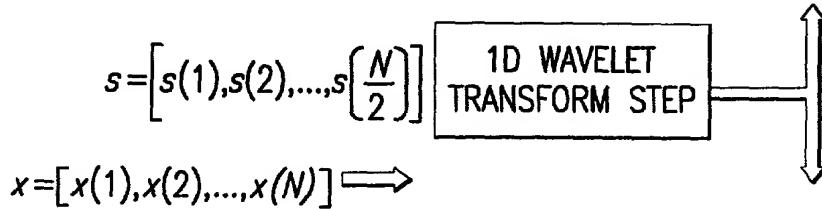
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1800



$$d = [d(1), d(2), \dots, d(\frac{N}{2})]$$

$$X = \begin{bmatrix} x(1,1) & x(1,2) & \cdots & x(1,N) \\ x(2,1) & x(2,2) & \cdots & x(2,N) \\ \vdots & \vdots & \ddots & \vdots \\ x(M,1) & x(M,2) & \cdots & x(M,N) \end{bmatrix}$$



1801

2D WAVELET
TRANSFORM STEP

$$\hat{X} = \left[\begin{array}{c|c} LL & HL \\ \hline LH & HH \end{array} \right] = \begin{array}{|c|c|c|c} \hline & \cdots & II(1,N/2) & hI(1,1) \cdots hI(1,N/2) \\ \hline II(1,1) & \cdots & \vdots & \vdots \cdots \vdots \\ \hline \vdots & \ddots & \vdots & \vdots \cdots \vdots \\ \hline II(M/2,1) & \cdots & II(M/2,N/2) & hI(M/2,1) \cdots hI(M/2,N/2) \\ \hline \hline & \cdots & II(1,N/2) & hh(1,1) \cdots hh(1,N/2) \\ \hline lh(1,1) & \cdots & \vdots & \vdots \cdots \vdots \\ \hline \vdots & \ddots & \vdots & \vdots \cdots \vdots \\ \hline lh(M/2,1) & \cdots & lh(M/2,N/2) & hh(M/2,1) \cdots hh(M/2,N/2) \\ \hline \end{array} \right]$$

FIG.18

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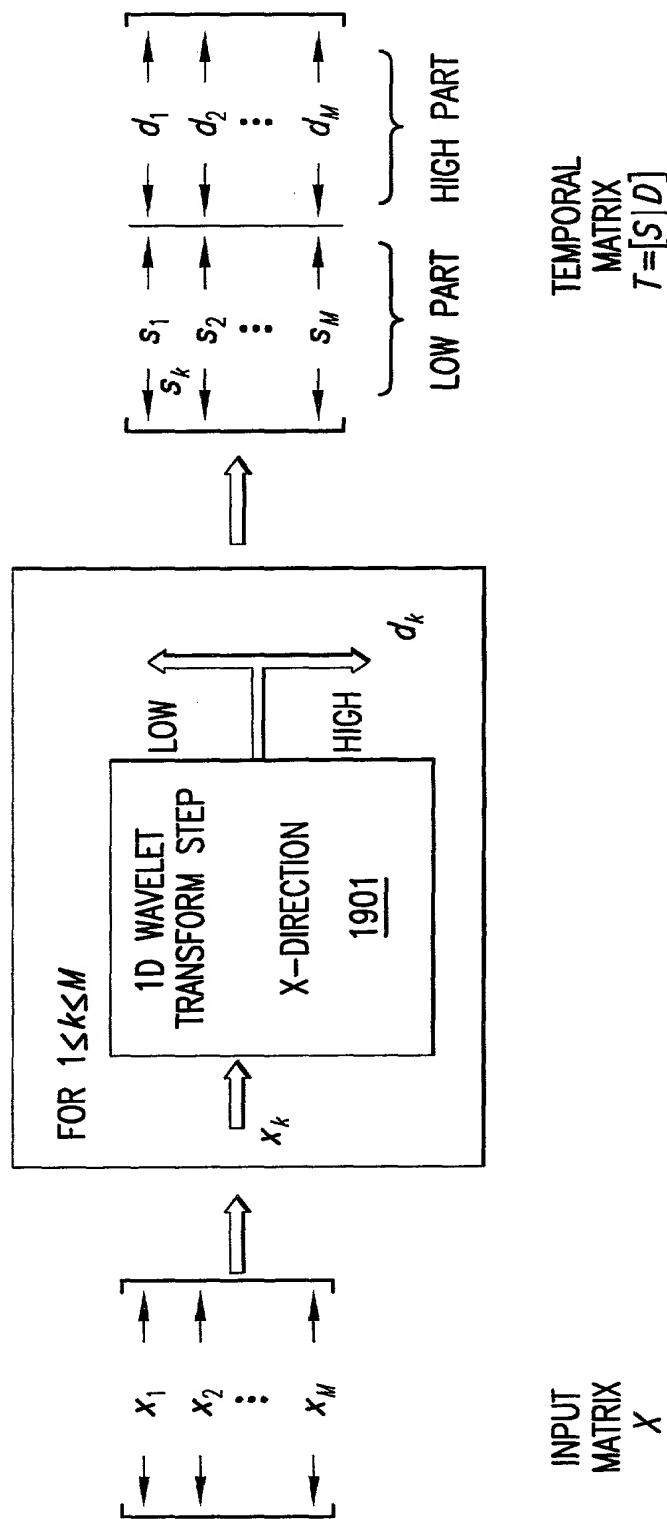


FIG. 19

1901

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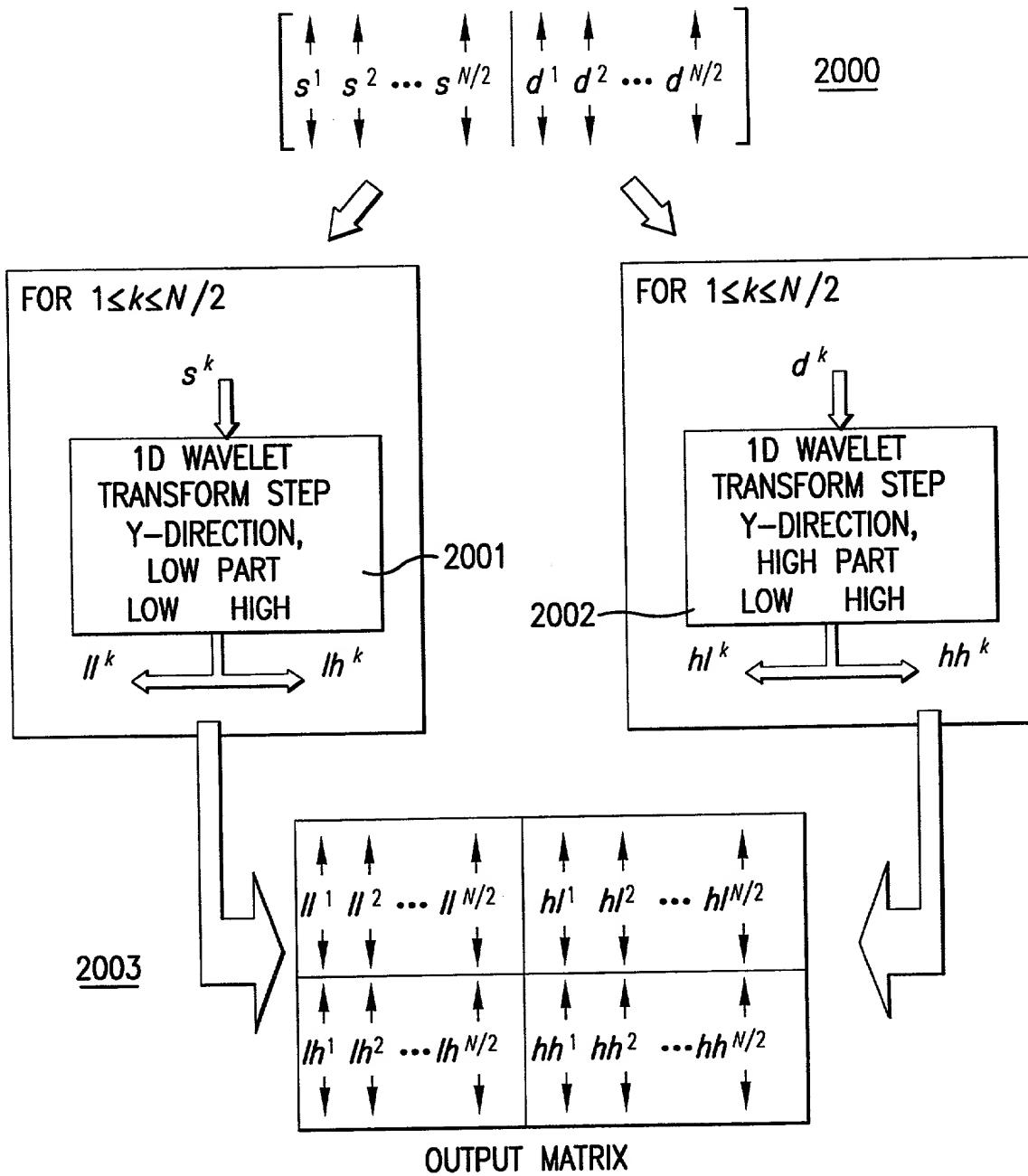
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$$\hat{x} = \left[\begin{array}{c|c} LL & HL \\ \hline LH & HH \end{array} \right]$$

FIG.20

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LET I BE THE ORIGINAL IMAGE,



FOR $0 < i < LEVELS$

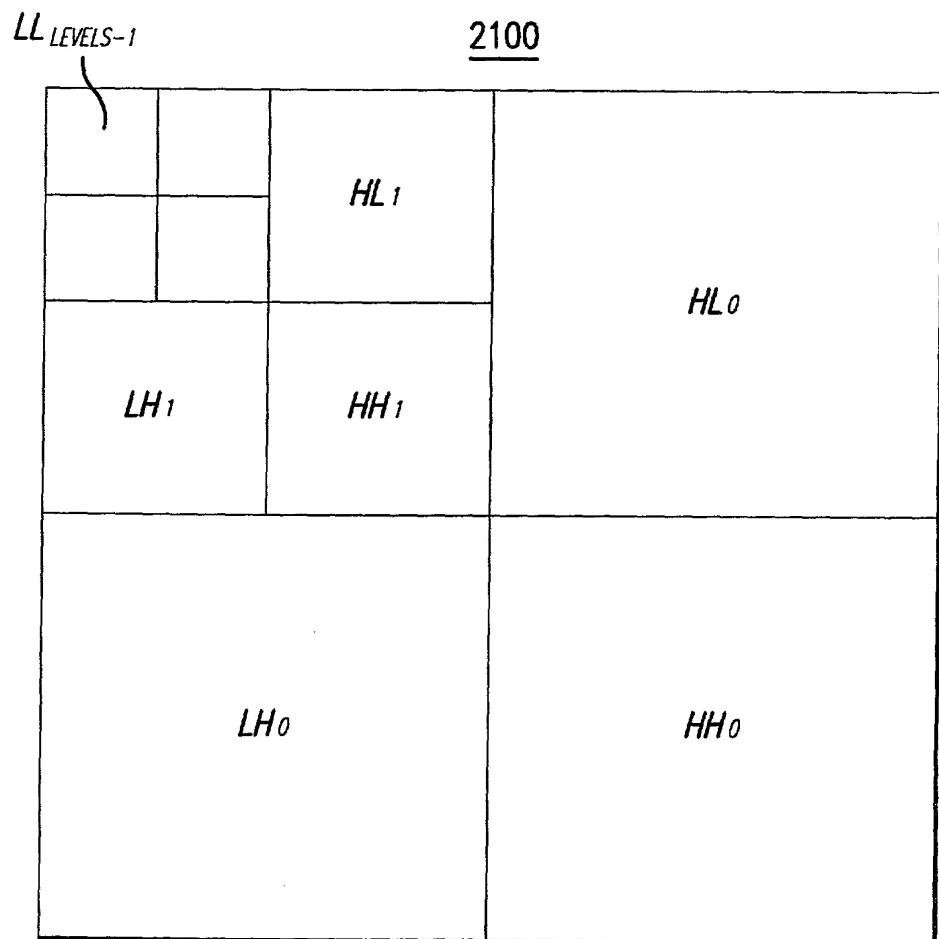


FIG.21

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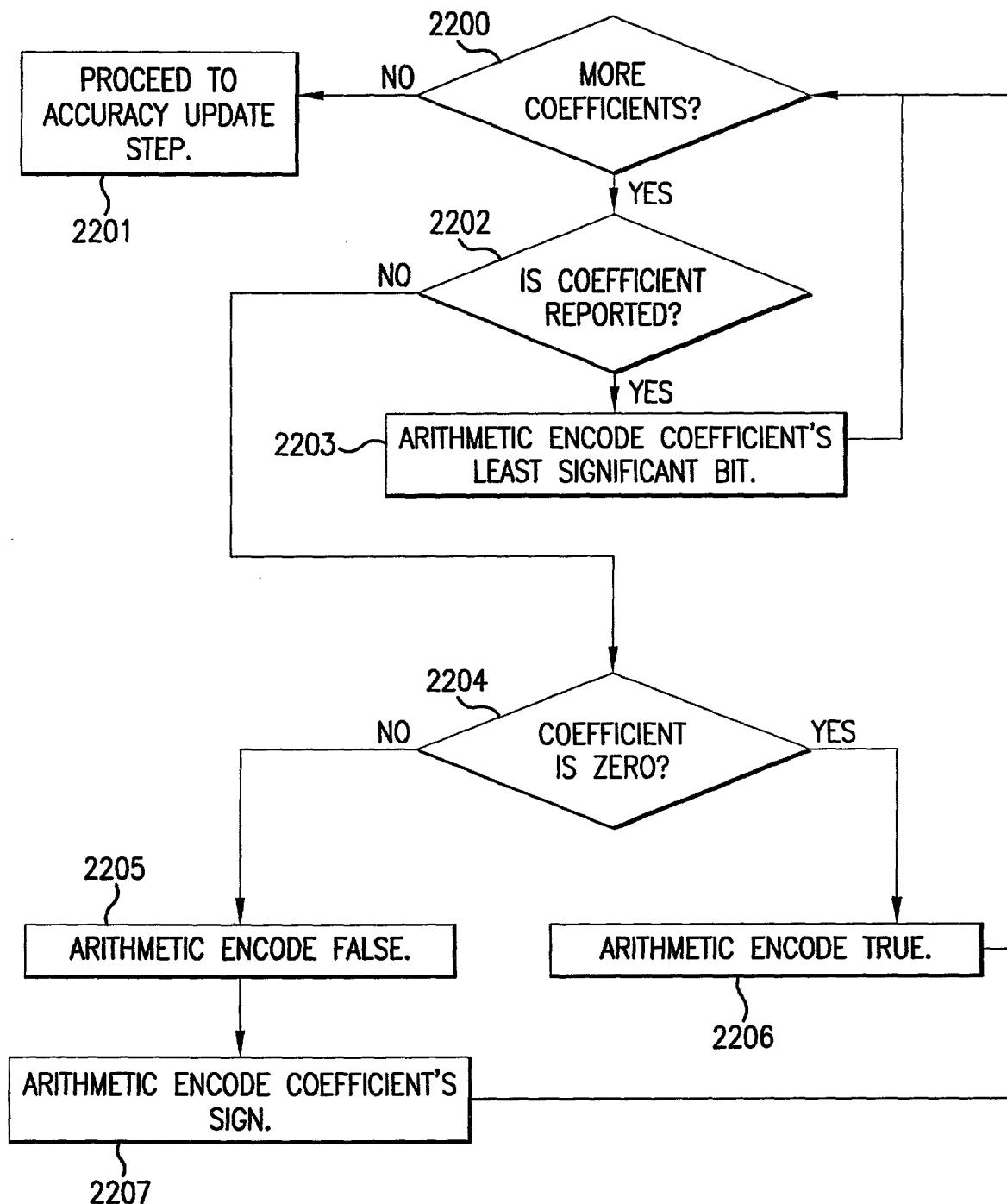


FIG.22

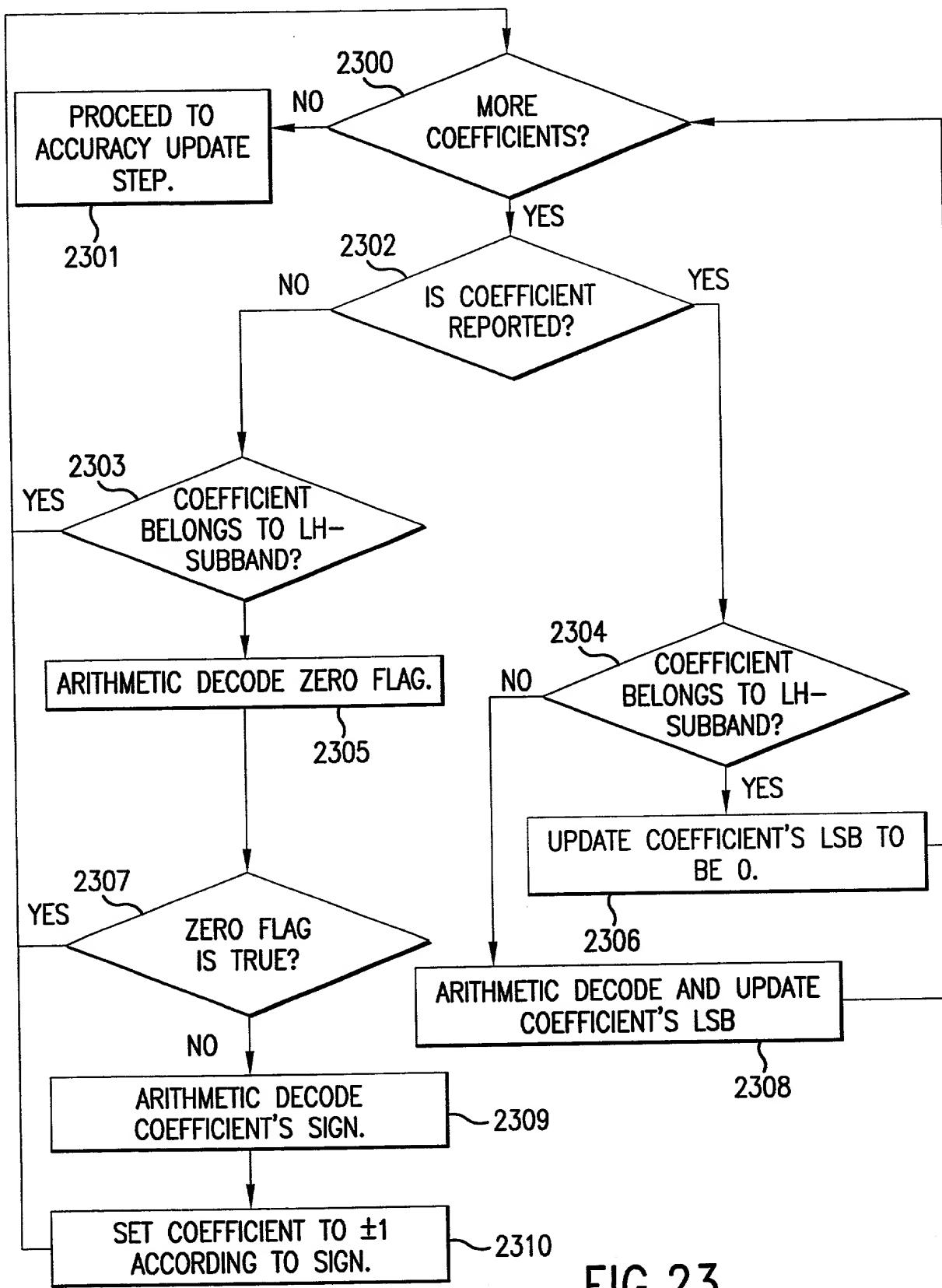


FIG.23

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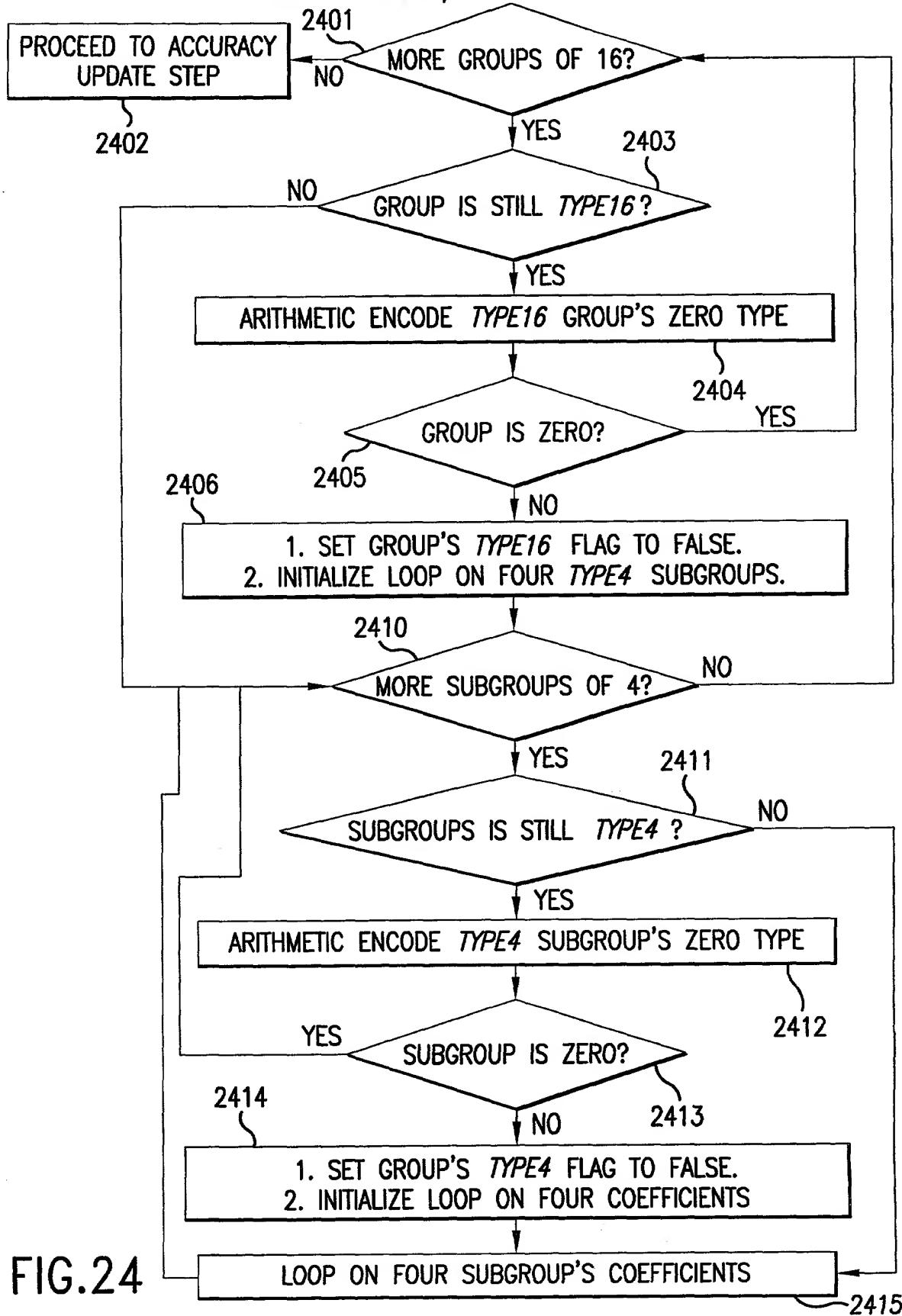


FIG.24

2415

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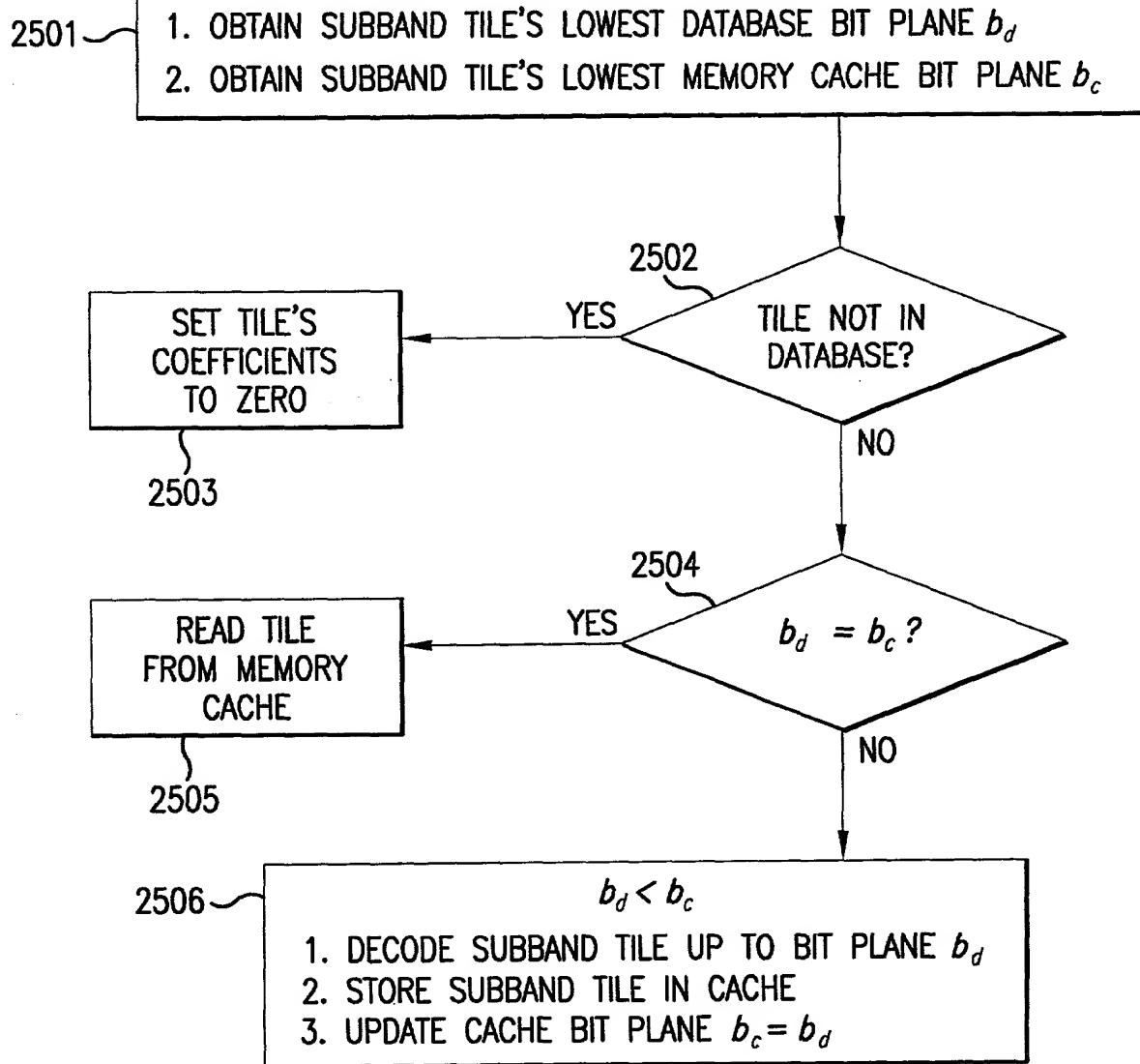


FIG.25

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PREPROCESSING MULTIRESOLUTION STRUCTURE

